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EXPOSURE

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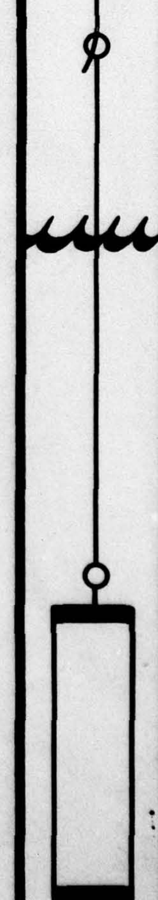
A METHOD OF ATTACHING ANODES TO METAL MOORING LINES

Stainless steel components are used for some moorings here at the Bedford Institute of Oceanography. A major limiting factor in the extension of operational life of mooring systems is the occurrence of crevice corrosion in stainless steels. This type of attack can result in catastrophic failure of some components and has been observed in the 4.75 mm diameter, type 316 or 302/304, stainless steel mooring wire and stainless steel swivels.

see 1473 back

In the past, Nocopress® sleeves and swaged terminations have been used to terminate mooring lines but, more recently, spliced terminations using a stainless steel thimble, of a size intended for 8.0 mm diameter wire, have been used to reduce galvanic effects. The wire splice is the conventional Liverpool® or spiral eye splice except that six full tucks, rather than the normal four tucks, are executed. The oversize thimble is used since it will stay in place if the splice loosens. However, since the risk of crevice corrosion still existed, it was decided to provide for the attachment of zinc anodes.



May 1978

Since split, bolted anodes are bulky and expensive to fabricate, a method of casting a cylindrical anode directly onto the component to be protected was developed (Figure 1). Anode grade zinc (Mil A 18001 H) is melted in a controlled electric melting pot and the anodes are cast using the cavity mold shown in Figure 2.

Initially, anodes were 2 cm diameter by 5 cm long but were found to be too small for some applications. Near the Gulf Stream, they have lasted 6 months (Figure 3), but in the Labrador Sea, anodes will be made 4 cm diameter by 7.5 cm long with double anodes on the current meters.

Anodes for other special purposes, such as those used on swivels (Figure 4) are easily cast using sand for molds or by machining aluminum or steel molds for repetative work.

After 2 years of experience with cathodic protection of mooring components, results are encouraging in that the incidence of crevice corrosion in stainless steel moorings exposed for up to 8 months has been virtually eliminated.

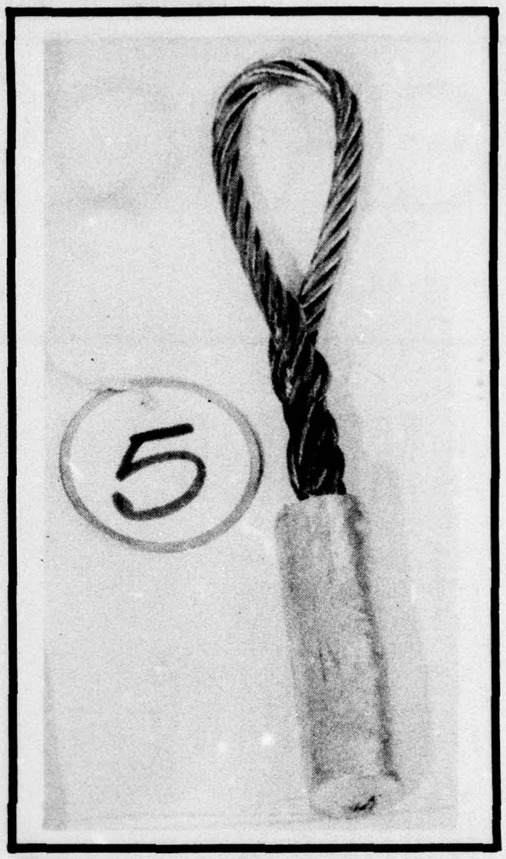


Figure 1.

Figure 2.

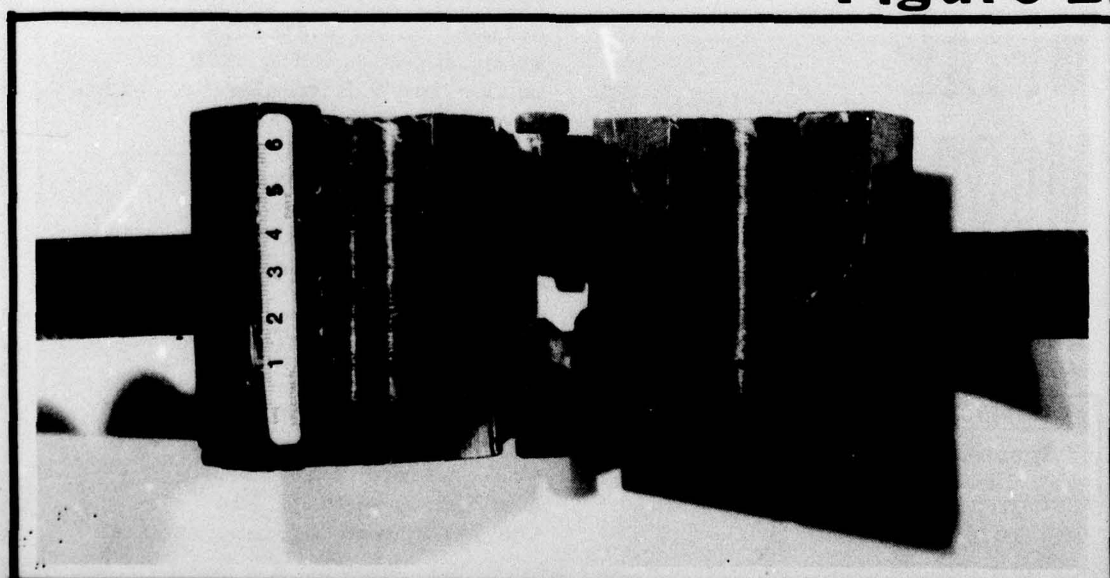


Figure 3.

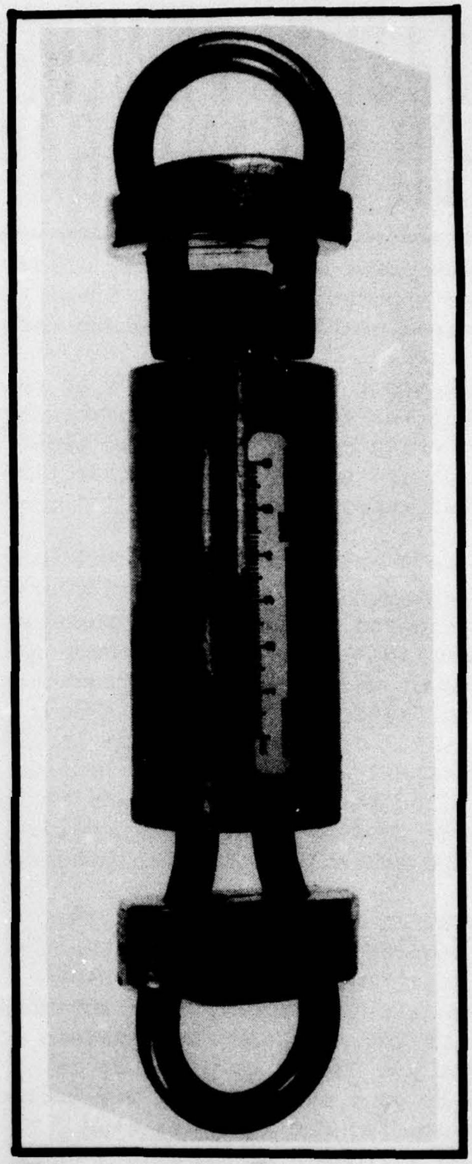


Figure 4.

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Sherman Glazebrook is an oceanographic technician in the Bedford Institute of Oceanography. His background in mechanical technology includes aircraft overhaul and mechanical design training in Nova Scotia and England. For the past several years he has been involved in the mechanics of the mooring program, including the deployment and recovery of long-term moorings. The emphasis of the program has been to extend the term of the moorings.

BATTERY POWERED MICROPROCESSORS FOR OCEANOGRAPHY

Lower power microprocessors allow more sophisticated remote field instrumentation than possible before.

This paper will be a review of the low power consuming microprocessors currently on the market and those which are scheduled for production later this year.

In 1977 only RCA and Intersil made microprocessors which could run on milliwatts of power. Now there are additional types of microprocessors, some of which execute instructions much faster and some much slower than the 1977 devices. Sometime in 1979 there will be a broader selection of devices to choose from, many of them being CMOS emulations of popular minicomputers and microcomputers.

INTERSIL 6100* is a 12-bit CMOS microprocessor which executes the Digital Equipment Corp. PDP-8E assembly language. Cross assemblers exist for most computer systems so that you do not have to buy or build your own software development system for the Intersil 6100. We used a cross assembler on a PDP-10 timesharing system on the University of Washington campus. The hardware prototyping system from Intersil costs $270[1]. TLF and Pacific Cyber/Metrix, Inc., make desk top computer systems using the Intersil 6100. Cybertek, Marsh-McBirney, and Sea Data Corp. make small CMOS microprocessor system cards using the Intersil 6100 which might be directly incorporated into oceanographic projects.

RCA 1802 is an 8-bit CMOS device which comes in a good prototyping kit but lacks an inexpensive software development system. Cross assemblers can be purchased for $1200 for HP-2100, CDC 6400, PDP-10 and some IBM computers. A typical commerical time-sharing service which has an RCA cross assembler is First Data (telephone: 202/872-0580), which charges $7.50 an hour connect time and 22¢ per CPU second for 25k words of memory. It would cost $2000 to $5000 to develop a project. The language of this microprocessor is two generations newer than the PDP-8 language. Its code may be twice as efficient as the PDP-8 code if you are working with 8-bit data.

TEXAS INSTRUMENTS SBP 9900 is a 16-bit I^2L device with lots of computing capability. The processor consumes 30 times as much power as the Intersil 6100, drawing 100 mA at 1.5 V for a 1 ms cycle time. However, this powerful instruction set includes such items as a multiply instruction, making it at least 100 times faster than the Intersil 6100 at multiplication. A bipolar prototyping kit from Tecnico costs $300. An inexpensive software development system does not exist for it. TI makes a biopolar and I^2L version of the same microprocessor. the I^2L version is designed for the military and is in short supply at $300 each.

FAIRCHILD 9440 is a 16-bit I^2L device which uses the Data General NOVA assembly language. There are almost as many NOVA assemblers and cross assemblers around as there are for the PDP-8, so software development should be easy for this device.

[1] "A Users Report on the Intercept Jr." by H. LaHore, Byte, December 1977.

Fairchild's prototyping kit costs $750. The device was announced a year ago and it is just now available. In the future, they say they will have support boards and chips that will include such features as multiply/divide. This unit should be able to easily run Fortran, something that most of the microprocessor companies wish their devices could do.

MOTOROLA 14500B is a 1-bit CMOS controller. Its 16 instructions looks skimpy compared to the Intersil's 42 instructions or RCA's 91 instructions. It is basically a device to replace or greatly reduce the amount of logic hardware in an application like complex traffic light control. They have a good hardware prototyping system for several hundred dollars. A software development system is probably not necessary for so simple a device.

NATIONAL SEMICONDUCTOR M58102 is a 4-bit CMOS calculator. This is just the opposite function of the Motorola unit (above) in that this device is very good at calculation but very poor at control.

INTERSIL 8048 is an 8-bit CMOS device scheduled for production late this year. It will emulate the INTEL 8048, and will have 1k ROM. They will also make a 8748 device with a 1k EPROM. RCA also announed they will be making the 8048 and 8085 devices with SOS.

MITEL 46802 is an 8-bit CMOS device also due late this year. It will be a CMOS version of the Motorola 6802 with 2k bytes of RAM on the chip.

Should you use a microprocessor in your next project? The answer should be no if you can do the project with hardware. Your first microprocessor project will definitely cost more and take more time than a straight hardware design. Due to their complexity, microprocessor systems are difficult for technicians to develop and repair without a lot of training. However, once understood, a microprocessor can be used in more sophisticated applications and the system is easier to debug and check out than hardware, due to its fewer parts and programmability.

*Previous users of the Intersil 6100 should note that when the pull-up resistors are sized for battery operation on the CMOS memory, the data in memory would change if the memory was strobed in an unsettled mode. Since the memory strobe signal LXMAR was activitated with every computer instruction, the chance of data modification was high. This feature has been eliminated in all units manufactured after mid-1977 and they can be identified by a date code followed by the letter "D".

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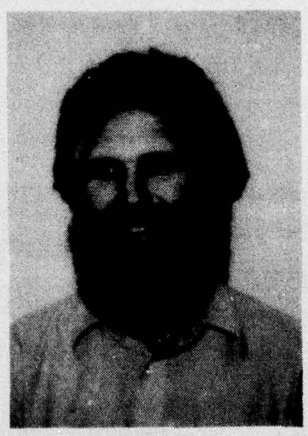


Henry Lahore received a B.S.E.E. in 1967 and a M.S.E.E. in 1969 from the University of Washington. He then worked in Atmospheric Sciences as instrumentation engineer until 1975, while setting up a computer system for data acquisition and analysis and making several remote digital data recording systems. Since joining the Oceanography Department in 1975 as principal engineer, he has developed two battery powered microcomputer systems and changed the departmental computation to PRIME computers.

A MINIATURE SUBMERSIBLE WIRE SPLICE

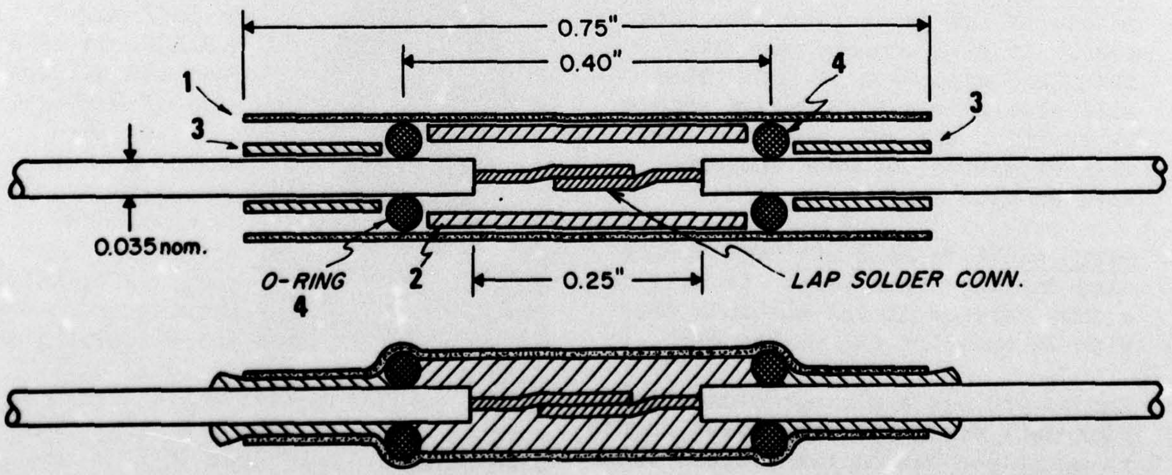
TABLE 1.

SPLICE SPECIFICATIONS

1.	Environment:	Repeated deployment to 1000 psi in ocean conditions.
2.	Procedure:	Reliable when made under ship-deck conditions. Simple to disassemble.
3.	Wire:	small (24-30 gauge)
4.	Insulation:	Tough and smooth (Tetzel or TFE/ polyethylene copolymer).
5.	Mechanical:	Limited bending relief capability to prevent flexing failure of wire.

The development of Oregon State University's Distributed Instrumentation Profiling System[1] (DIPS) included a requirement for a small, submersible wire splice. The specifications for the splice are shown in Table 1.

The first version of the splice consisted of a small crimp sleeve to join the wires. The crimp sleeve was insulated with heat shrink tubing and the ends were sealed with small O-rings. This splice was successful in meeting most of the requirements. The major drawback was the crimp sleeve which required the use of a crimping tool in limited spaces during installation, and the sleeve also made the splice just a little larger than was preferable. Despite these drawbacks, this splicing scheme did demonstrate that heat shrink tubing and O-rings could be used to provide excellent isolation between a splice and water with pressure tests to 1000 psi.



Numbers correspond to those in Table 2.

figure 1. Miniature Splice Detail

[1]Mesecar, Rod and Frank Evans. "Distributed Instrumentation Profiling System". EXPOSURE, Vol. 5, No. 3, pp 1-7, July 1977.

The second version of the splice, shown in Figure 1, simply eliminated the crimp sleeve. The resulting splice is simpler in the sense that a large tool does not have to be used in a limited space in order to make the splice. The splice does, however, require soldering for which some care is needed.

The materials used in the second splice--for 30 gauge wire with .25 mm insulation--are shown in Table 2. The outer sleeve material is a translucent heat shrink tubing which becomes clear when shrunk. This provides both a good visual indication of proper shrink and simple inspection of the finished splice. The inner sleeve material simply melts when warmed; it fills voids, provides backing for the O-rings, and is transparent after melt for visual inspection.

The assembly procedure for this splice starts with the unstripped wire ends. Before stripping, one end sleeve and one O-ring (in that order) are slipped 5 cm down each wire. Then one outer sleeve and one inner sleeve are slipped over one wire. Next, approximately 4.75 mm of insulation is stripped from each wire. We have found the "No-Nik" (Clauss Tools) to be ideal for performing this step on Tefzel®· insulated wire. The wire ends are twisted and lap soldered. The insulation components are then slid into place. The ends of the inner end sleeves can be used to position the O-rings; care must be taken that the O-rings are actually on the wire insulation. When these parts are in place, a heat gun is used to shrink the pieces. We use an Ungar "Princess" with a "J" shaped heat deflector on the nose; the deflector goes around the splice to provide heating from all sides. In performing this step, care should be taken to start at one end and progress toward the other; otherwise, air bubbles can be trapped between the O-rings.

This procedure can also be used to make wire-to-potting transitions for

TABLE 2.

SPLICE MATERIALS

1.	Outer sleeve:	Thinwall heat shrink tubing; 2.4 mm inches in diameter by 19 mm long (AMP type L-79F p/n/ 603344-1)
2.	Inner center sleeve:	Clearmelt linear tubing; 4.75 mm diameter by 8.7 mm inches long (AMP p/n 3-603398-1)
3.	Inner end sleeve:	Clearmelt linear tubing; 3.175 mm diameter by 4.75 mm inches long (AMP p/n 2-603398-1)
4.	O-ring:	.74 mm inside diameter by 1.0 mm inches cross section (Minnesota Rubber #8001)

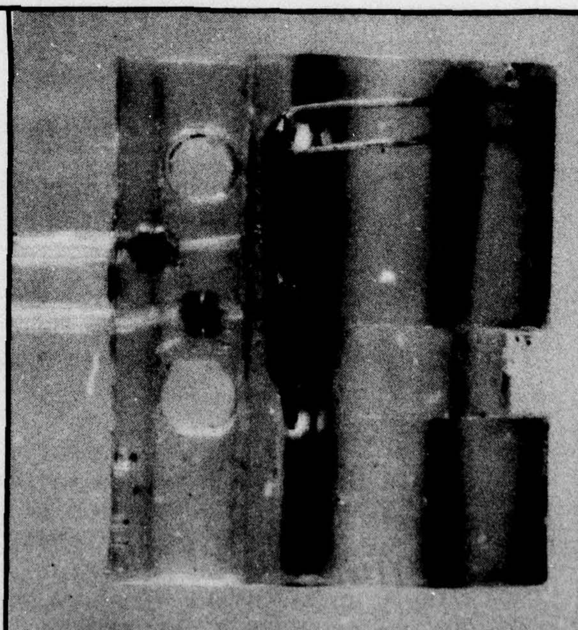


figure 2. Urethane-potted thermistor assembly with O-ring and tubing wire transitions.

wires with insulation similar to Tefzel®. Figure 2 shows an application involving a wire-to-potting transition used on thermistor assemblies which are also part of the DIPS system. In this situation, two O-rings are used next to each other. Heat shrink tubing covers the O-rings and wire. No-melt tubing is used in this case and the O-rings are within the position of the transition which is potted. The portion of the heat shrink tubing which extends out of the potting serves as a bending relief.

In summary, the O-ring compression splice procedure provides a simple, reliable, and moderately rugged small wire splice for use <u>in situ</u>.

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T A B L E   O F   C O N T E N T S

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